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The application of coulometry for total antioxidant capacity determination of human blood

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Abstract

New coulometric method for estimation of blood and plasma total antioxidant capacity (TAC) based on using electrogenerated bromine was proposed. TAC of blood from patients with chronic renal disease undergoing long-term hemodialysis was investigated. Statistical significant changes in TAC level of venous and arterial blood were found. Catalase activity and low density lipoproteins (LDL) concentrations were determined. Linear correlation between TAC and parameters mentioned was found. Contribution from some individual antioxidants was investigated. The developed method for TAC assay is expressive, simple, stable and reliable, and successfully could be used for TAC determination of some biological fluids. This method could be applied in clinic for estimation of blood TAC from patients.

Keywords: Total antioxidant capacity; Coulometric titration; Chronic renal failure; Blood; Catalase; Low density lipoproteins

1. Introduction

Living cells are continuously exposed to a variety of challenges that exert oxidative stress. These could stem from endogenous sources through normal physiological processes such as mitochondrial respiration and haemoglobin oxidation. Alternatively, they could result from exogenous sources such as exposure to pollutants, ionizing irradiation and other extreme factors [1].

Oxidative stress is often associated with or leads to the generation of reactive oxygen species (ROS) including free radicals. Their amount depends not only from generation rate but also from antioxidant defense system of human body particularly of blood. Violation in its antioxidant properties leads to the development of pathological state [2,3] because ROS are strongly implicated in the pathophysiology of diseases such as cancer, heart diseases and atherosclerosis, aging, diabetes mellitus, renal, inflammatory, infectious and neurological diseases [4].

There are different mechanisms of antioxidant action in biological fluids. The first is decreasing the level of active products from oxygen reduction and another way is removing the transition metals group (Fe, Cu) by their bounding with proteins. This leads to inhibition of free radical reactions [5,6]. Free radicals are also eliminated from the body by their interaction with antioxidants.

Two classes of antioxidants are known: the low-molecular weight (LMW) compounds (tocopherols, ascorbate, β-carotene, glutathione, uric acid, bilirubin, etc.) and the proteins (albumin, transferrin, caeruloplasmin, ferritin, superoxide dismutase, catalase, glutathione peroxidase, etc.) [7]. TAC parameter summarizes overall activity of antioxidants and antioxidant enzymes. The depletion of TAC induced by oxidative stress is eliminated by release of stock organ antioxidants, mainly from liver and adipose tissue and the induction or activation of antioxidant enzymes. At a later phase of oxidative stress, the TAC falls due to depletion of

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